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Predictions of upcoming discourse structure based on “On the one hand”

Introduction

Given evidence of anticipation within sentences for dependencies between upcoming sounds, words, and syntactic structures (e.g., Kamide, Altmann & Haywood, 2003; Levy, 2008; Staub & Clifton, 2006), an open question is whether comprehenders anticipate upcoming discourse dependencies across multi-sentence passages. Within sentences, words combine via syntactic rules to determine which structures are possible. Between sentences, the possible relationships that can hold between pairs of propositions, such as *cause-consequence* and *claim-argument*, create a less constrained discourse structure (Hobbs, 1990). However, certain linguistic cues do constrain the possible structures, such as the expression “On the one hand” (OT1H). OT1H signals to the reader that an upcoming contrast is to be expected, but it does not fully constrain when this contrast needs to occur or what precise form it will take. In this work, we test how comprehension is affected by the discourse-structuring device OT1H and find evidence for fine-grained anticipatory processing.

A closer look at the 13,000 instances of OT1H in the ukWaC corpus (a 2 billion-word corpus of English webpages, Ferraresi et al., 2008) shows that, although OT1H most often occurs with “On the other hand” (OTOH) in the same sentence (61%), the pair of markers can also occur in adjacent sentences (15%) or with intervening sentences between OT1H and OTOH (7%). When intervening sentences occur between OT1H and the second argument of the contrast relation, readers must build a sufficiently rich discourse structure to link the OT1H and OTOH sentences even though they are not adjacent, and to process intervening coherence relations (also see Asher & Lascarides, 2003). For the remaining 17%, OT1H occurred without OTOH. In these cases, the second argument of the contrast was often marked with other connectives, such as *but*, *although*, and *at the same time*.

Given that OT1H allows for variation in discourse structure, size, and marking, it functions as a suitable cue to test the generation and maintenance of discourse-level expectations across multiple sentences (cf. Rohde & Horton, 2014). More specifically, our goal is to test whether OT1H causes readers to specifically anticipate a subsequent cue phrase (OTOH) or, more generally, a subsequent sentence describing a contrasting state of affairs. Furthermore, we test whether comprehenders build and maintain sufficiently fine-grained discourse structures to show sensitivity to the attachment of the intervening contrast clause (contrast with OT1H-argument vs. a more local contrast).

Methodology

We conducted three experiments to investigate these questions, using passages such as (1) with one of the (a-c) intervening sentences.

- | | | |
|-----|------------------|---|
| (1) | Intro | Joseph is pondering whether he should take a job offer from the zoo. |
| | OT1H | On the one hand, he needs the money that this job will pay, |
| | Cause | because he should start paying off his student loans. |
| | a. None | Also, his car needs to be serviced by the end of the month. |
| | b. Local | But the loans could be deferred for a few more months. |
| | c. Global | But he could keep looking for a nicer, better-paying job. |
| | OTOH | On the other hand, he hates the idea of cleaning out panda cages every day. |

Condition (a) functions as a baseline condition: the intervening sentence does not satisfy the expectation for an upcoming contrast. The content in (b) contrasts with the content of the because-clause, and therefore creates a local contrast. Finally, (c) contrasts with the content of the OT1H-clause, thereby creating a global contrast. The difference between conditions (b) and (c) is illustrated in Figure 1.

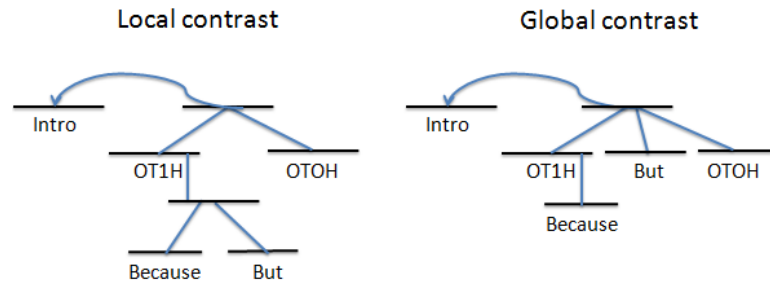


Figure 1. Attachment height of intervening sentences.

We test three hypotheses for comprehenders' expectations of contrast:

- H1:** OT1H cues the surface form OTOH specifically; (a-c) are indistinguishable with respect to the anticipation and processing of OTOH.
- H2:** OT1H cues a general contrast without sensitivity to discourse structure; this contrast may be marked by connectives other than OTOH. Both (b) and (c) satisfy this expectation and disfavor a subsequent OTOH clause.
- H3:** OT1H cues a structure-sensitive contrast that targets the content of the OT1H-clause specifically; this contrast may be marked by connectives other than OTOH. Only (c) satisfies structure-sensitive expectations and disfavors a subsequent OTOH clause.

Results

Across the experiments, comprehenders demonstrated sensitivity to discourse structure. In a coherence judgment experiment, participants ($n=144$) assessed passages such as (1) with and without the OTOH-sentence (between subjects design). As illustrated in Figure 2, stories including the OTOH-sentence were preferred in conditions (a) and (b) ($p < .001$ and $p < .05$, respectively), but not in condition (c). This supports H3 and speaks against H2.

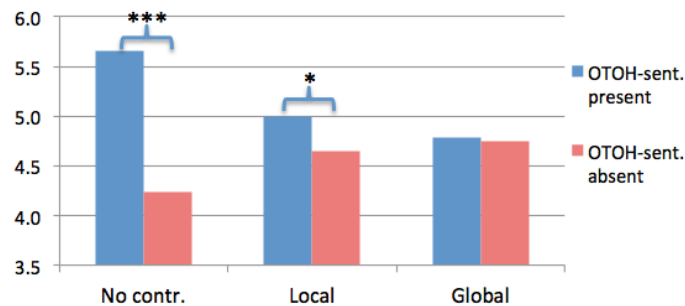


Figure 2. Mean ratings of stories per condition.

These results were further supported in a story completion experiment, where participants ($n=90$) completed stories without the OTOH-sentence. There were fewer contrastive continuations in condition (c) than in conditions (a) or (b) (both $p < .001$) (a: 79%; b: 35%; c: 10%, Figure 3). This supports H3 over H2. Furthermore, 29% of contrastive markers were connectives other than OTOH (e.g. *but*, *although*). This speaks against H1.

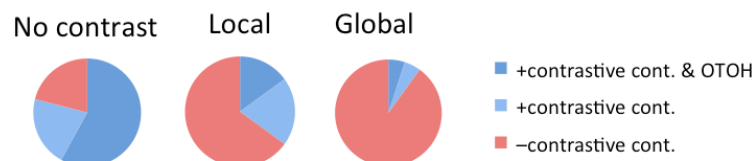


Figure 3. Percentage of contrastive continuations per condition.

The global/local distinction was also found to be relevant in an eye-tracking study (n=32): results showed longer first fixation and regression path durations on the expression "On the other hand" in condition (c) (342 ms) than in conditions (a) (313 ms) ($\beta = 28.58, p < .05$) and (b) (311 ms) ($\beta = -30.35, p < .05$). No such difference was found between conditions (a) and (b) ($\beta = -0.37, p = 0.98$). This supports H3 over H2.

Discussion and Conclusion

Taken together, the results of these three experiments indicate that a local contrast does not completely satisfy the expectation of contrast set up by OT1H, but a global contrast does. Hence, the results provide evidence for H3: readers construct and update predictions of discourse structure based on OT1H rapidly while reading, leading to longer reading times at OTOH after a globally contrastive sentence.

We interpret the effect observed in these experiments as evidence for discourse anticipation (as opposed to an effect of integration) due to our results in the online eye-tracking experiment: we observe a difference in reading times on the connective "on the other hand" which is a marker of contrast, but does not carry any propositional meaning that would justify the observation of an integration effect with the argument of OT1H.

We conclude that readers anticipate upcoming relations across multiple sentences. These predictions are structure-specific, and can be elicited by cues such as OT1H. The findings are likely to generalize to other cues marking larger discourse structures, such as list markers (*First... Second...*).

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